

# Physioex 9.0 exercise 2 assignment



**ASSIGN  
BUSTER**

Skeletal Muscle Physiology Student instructions: Follow the step-by-step instructions for this exercise found in your lab manual and record your answers in the spaces below. Submit this completed document by the assignment due date found in the Syllabus. Rename this document to include your first and last name prior to submitting, e. g.

Exercise2\_JohnSmith. doc. Please make sure that your answers are typed in RED. (You may delete these instructions before submission. ) Grading: True/False, Multiple-Choice, and Fill-in-the-blank type questions will be worth 1 point each whereas Short-answer type questions will be worth 2 points each.

This lab will be worth a total of 76 points but will be converted to a percentage grade when registered in your “ Gradebook”. | ACTIVITY 1: The Muscle Twitch and the Latent Period | Answers | | The latent period of the skeletal muscle that was tested in this lab simulation was | C | | about 1 second. | | less than 1 msec. | | | between 2-3 msec. | | | variable, depending on the voltage that was applied to it. | | | True or False: Another name for a muscle cell is “ myofibril. | False | | The largest active force that could be generated in the muscle is Activity 1 was \_\_\_\_\_ grams. | 1. 82 | | Define the terms skeletal muscle fiber, motor unit, skeletal muscle twitch, electrical stimulus, | Skeletal muscle fiber- is one of hundreds to thousands of | | and latent period. individual cells that are myofibrils. Skeletal muscles are | | | connected to bones by tendons. | | | Motor unit- is one motor neuron and all the skeletal muscle | | | fibers it innervates. | | Skeletal muscle twitch- one contractile response to a single | | | action potential. | | | Electrical stimulus- delivers the desired amount and duration of | | | stimulating voltage to the

muscle via electrodes resting on the muscle. Latent period-period of time that elapses between the generation of an action potential in a muscle cell and the start of the muscle contraction. What is the role of acetylcholine (ACh) in a skeletal muscle contraction? It is a neurotransmitter that is an action potential in a motor neuron. Describe the process of excitation-contraction coupling in skeletal muscle fibers. The process occurred during the latent period and was isometric in contractions causing all the steps of the excitation-contraction coupling to occur. Describe the three phases of a skeletal muscle twitch. Latent phases which is the interval from stimulus application until the muscle begins to contract. Contraction phase-which the muscle fibers shorten. Relaxation phase- which is the downward curve found in our findings. The muscle is going back to its original state. Does the duration of the latent period change with different stimulus voltages? No activity in all tests. At the threshold stimulus, do sodium ions start to move into or out of the cell to bring about the membrane depolarization? They start to move into the cell to bring about membrane depolarization. ACTIVITY 2: The Effect of Stimulus Voltage on Skeletal Muscle Contraction. The threshold voltage for the muscle in this lab simulation was \_\_\_\_\_ volts.

When that voltage .8 volts and .02 grams was used to stimulate the muscle, \_\_\_\_\_ grams of active force were generated. True or False: In a resting skeletal muscle cell, most of the calcium ions freely move through the cytoplasm of the cell. False. Describe the effect of increasing stimulus voltage on isolated skeletal muscle. Specifically, what happened to the voltage is increased past the muscle's threshold voltage,

muscle force generated with stronger electrical stimulations and why did this | the amount of force in the entire muscle increases. Each time | | change occur? | the voltage was increased the force generated from the muscle | | | also increased.

This occurred because the voltage increased and | | | was delivered to the whole muscle, so more fibers were then | | | activated which causes total force produced by the muscles to | | | increase. | | How is this change in whole-muscle force achieved in vivo (eg. in the human body)? The increase of electrical current causes a progressive | | | increase in the amount of muscle force based on the amount of | | | electrical current because it must surpass the threshold | | | voltage. | | What happened in the isolated skeletal muscle when the maximal voltage was applied? All the muscle fibers contained in this muscle are depolarized | | | and they all develop active force. | |

**ACTIVITY 3: The Effect of Stimulus Frequency on Skeletal Muscle Contraction** | |

**True or False:** There is no limit to the amount of force that a skeletal muscle can generate if it | False | | is stimulated by a high enough voltage at a very high frequency. | |

The chemical ion or molecule that is primarily responsible for initiating the contraction of a | C | | muscle fiber is | |

| | Na<sup>+</sup> | | | K<sup>+</sup> | | | Ca<sup>2+</sup> | | | ADP | | |

What is the difference between stimulus intensity and stimulus frequency? Stimulus intensity describes the amount of force generated to | | | administer the stimulus. Stimulus Frequency is the rate of | | | delivered stimulus to the muscle. | |

In this experiment you observed the effect of stimulating the isolated skeletal muscle multiple |

When stimulating the isolated skeletal muscle multiple times in | | times in a short period with complete relaxation between the

stimuli. Describe the force of | a short period with the complete relaxation between each stimuli| | contraction with each subsequent stimulus. Is this called treppe or wave summation? the amount of force between each stimulus is increased | | progressively to a max peak in which a plateau of the force | | occurred. This is a treppe. | | How did the frequency of stimulation affect the amount of force generated by the isolated skeletal |

When the frequency was increased to the point in which a muscle | | muscle when the frequency of stimulation was increased such that the muscle twitches did not fully | relaxation didn't occur the amount of force increased with each | | relax between subsequent stimuli? Is this called treppe or wave summation? | stimulus.

Wave summation occurred. | | To achieve an active force of 5.2 g, did you have to increase the stimulus voltage above 8.5 volts? | No, I didn't have to increase the voltage above 8.5volts. In | | If not, how did you achieve an active force of 5.2 g? | order to achieve an active force of 5.2g the stimuli needed to | | be delivered in rapid succession in a short amount of time and | | not allowing for full relaxation of the muscle. In order to get | | 5.2g of active force wave summation needed to be performed. |

ACTIVITY 4: Tetanus in Isolated Skeletal Muscle | | When stimuli were applied to the muscle frequently enough to cause a plateau in the amount of force| Unfused Tetanus | | generated, a state known as \_\_\_\_\_ occurs. | |

Why do children (and adults) receive an immunization (actually several! ) called a “ tetanus shot”? | C | | This will prevent the development of muscle fatigue when she/he becomes an athlete. | | The person will then be able to develop the maximum amount of force from ach and every muscle in | |

her/his body. | | | To prevent the development of a condition called “ lockjaw” that can develop from a specific | | | bacterial infection. | | | This will a reminder to her/him to keep the skin washed and clean when she/he is outside playing. | | | The maximal tetanic tension of the muscle in this simulation was \_\_\_\_\_ grams. | 5. 5 grams | | Describe how increasing the stimulus frequency affected the force developed by the isolated whole | When the frequency was at the low of 50s/s the force was at its | | skeletal muscle in this activity. | lowest level out of all the labs. As the frequency was | | | increased to 130 s/s the force increased slightly but fused | | | tetanus developed at a higher freq. When the stimulus freq was | | | increased to the amount of 145-150 s/s the force reached a | | | plateau and maximal tetanic tension occurred. | Indicate what type of force was developed by the isolated skeletal muscle in this activity at the | 50 stimuli/second- Unfused tetanus | | following stimulus frequencies: at 50 stimuli/second, at 140 stimuli/second, and above 146 | 140 stimuli/second- Fused Tetanus | | stimuli/second. | 146 stimuli/second- Maximal Tetanic Tension | | Beyond what stimulus frequency is there no further increase in the peak force? What is the muscle | Maximal tetanic tension | | tension called at this frequency? | | | ACTIVITY 5: Fatigue in Isolated

Skeletal Muscle | | True or False: The primary reason for muscle fatigue is the buildup of  $Ca^{2+}$  ions in the muscle | False | | fiber. | | | If an intervening rest period is imposed on active muscle, | B | | it will then be able to generate much more force. | | | the development of fatigue will be delayed. | | | muscle hypertrophy can be prevented. | | muscle atrophy can be prevented. | | | When a skeletal muscle fatigues, what happens to the contractile force over

time? | When a muscle fatigues the contractile force declines due to | | | previous contractile activity. Once the muscle has reached | | | maximum tetanic tension there is no longer an increase in the | | | force generated by the muscle.

At that stage the muscle becomes | | | fatigued and contractile force starts to decrease over a period | | | of time. | | What are some proposed causes of skeletal muscle fatigue? | The buildup of lactic acid, ADP, and Pi in the muscle fibers as | | | well as Calcium levels decreasing. | | Turning the stimulator off allows a small measure of muscle recovery. Thus, the muscle will produce | Turning it off, a period of rest is created allowing the | | more force for a longer time period if the stimulator is briefly turned off than if the stimuli | concentrations of intercellular concentrations of ADP, lactic | | were allowed to continue without interruption. Explain why this might occur. | acid, and Pi to decrease. From there a longer time to achieve | | | maximum tension increases. If the simulator wasn't turned off | | | the muscle would not reach a rest period and fatigue would | | | continue. | | List a few ways that humans could delay the onset of fatigue when they are vigorously using their | Healthy diet, adequate exercise, allowing rest periods in | | skeletal muscles. between set's | | **ACTIVITY 6: The Skeletal Muscle Length-Tension Relationship** | | In a force-length graph, | D | | the muscle length is the independent variable. | | | the amount of force generated is the dependent variable. | | | both active and passive forces must be considered. | | | All the above are correct. | | | According to your lab manual, the protein titin is the primary cause of \_\_\_\_\_ . Passive Force | | In this lab simulation, the muscle length of \_\_\_\_\_ mm was able to generate the largest active |

75mm | | force. | | | The force that results from muscles being stretched is called | B | | active force. | | | passive force. | | | maximal tetanic force. | | stretch force. | | | What happens to the amount of total force that the muscle generates during the stimulated twitch? | It is altered by the starting resting length. | | Based on the unique arrangement of myosin and actin in skeletal muscle sarcomeres, explain why | Active force is generated from myosin thick filaments bind to | | active force varies with changes in the muscle's resting length. | thin actin filaments engaging the cross bridge cycle and ATP | | | hydrolysis.

Active force data changes as the resting length of | | | the muscle changes. When the resting length of the muscle is | | | shortened the active force amount increases. When the length of | | | the muscle is lengthened the active force decreases. The change | | | in active force amount is completely caused by the amount of | | | myosin bound to the actin. | | What range of skeletal muscle lengths generated passive force? 80, 90, & 100 | | If you were curling a 7-kg dumbbell, when would your bicep muscles be contracting isometrically? | At any point in which the bicep muscle remains at a fixed | | | length. | | ACTIVITY 7: Isotonic Contractions and the Load-Velocity

Relationship | | The fastest muscle contraction velocity measured in this part of the simulation occurred with the | D | | \_\_\_\_\_ weight. | | | 2. gm | | | 1. 5 gm | | | 1. 0 gm | | | 0. 5 gm | | | The fastest muscle contraction velocity in this simulation was approximately \_\_\_\_\_ mm/msec. |. 00 | | True or False: A muscle that is contracting isometrically will fatigue much slower than one that | True | | is contracting isotonicly. | | | If you were using your biceps muscles to curl a 7kg dumbbell, when would your muscles be | When your



arm extends downward to the point of it being straight| | contracting isototonically? |& when the arm rises from the down position back to the raised | | | position. | Explain why the latent period became longer as the load became heavier in the experiment. | Latent period occurred when there was a rise in the muscle | | | tension but no movement or contraction of the muscle. It | | | happened because the increased weight of the load got heavier | | | and was necessary for the force generated by the muscle | | Explain why the shortening velocity became slower as the load became heavier in this experiment. | When the weight is heavy the speed in which the muscle lifts the| | | weight decreases in speed at a slower velocity. | Explain why it would take you longer to perform 10 repetitions lifting a 10kg weight than it would | It would take longer with the heavier weight because as the | | to perform the same number of repetitions with a 5kg weight. | weight of the load increases so does the latent period of time | | | and the shortening velocity speeds. Lighter the weight the | | | muscle is contracted quicker in both latent and velocity. | | Describe what would happen in the following experiment: A 2. 5g weight is attached to the end of | A-The muscle will generate force by passive force. | | the isolated whole skeletal muscle used in these experiments.

Simultaneously, the muscle is | B- if the platform that supports the weight is removed and the | | maximally stimulated by 8. 5 volts and the platform supporting the weight is removed. | 2. 5g weight is connected the weight would pull the muscle | | Will the muscle generate force? | downwards causing it to lengthen. The muscle changing length | | Will the muscle change length? | would not be from the result of muscle contractions, but

only | | What is the name for this type of contraction? | from the weight  
pulling it down. | | C-it would be an isometric contraction. |